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commercial blueberry growing

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COMMERCIAL BLUEBERRY GROWING

By D. H. SCOTT, A. D. DRAPER, and G. M. DARROW,¹ Northeastern Region,
Agricultural Research Service

Fruit from several species of blueberries is harvested commercially in the United States from cultivated and wild plantings. The most important of these species are highbush (*Vaccinium australe* and *V. corymbosum*), rabbiteye (*V. ashei*), lowbush (*V. lamackii*), dryland (*V. pallidum* and *V. altomontanum*), evergreen (*V. ovatum*), and mountain (*V. membranaceum*). Although all of these species are harvested wild, cultivated blueberries are the most important.

In addition, commercial quantities of the Canada blueberry (*V. myrtilloides*) are harvested wild in Maine and the Adirondack Mountains of New York. In the mountains of western North Carolina, two wild highbush blueberries (*V. altomontanum* and *V. constablaei*) are harvested commercially.

Blueberry varieties have been originated by hybridization and breeding of native wild species. This breeding has produced cultivated blueberries that are about three times the size of the largest wild berries (fig. 1).

The cultivated varieties are better than wild ones for marketing fresh.

Most wild blueberries are harvested for processing and for home use.

CULTIVATED BLUEBERRIES

The two cultivated species are highbush and rabbiteye. Highbush is native from southeastern North Carolina to southern Maine and west to southern Michigan. The native range of rabbiteye blueberries is southern Georgia, southern Alabama, and northern Florida.

Highbush

Highbush blueberries grow best in moist soil. The plants grow 10 to 15 feet high and are not drought resistant.

Weather conditions affect the flavor and other characteristics of the fruit. Generally, the berries are better flavored toward the northern limits of the growing area where the days are long and the nights are cool during the ripening season. In southern regions, the flavor is much better when the days are sunny and the nights cool.

Varieties

Varieties are classed as early, early midseason, midseason, late midseason, and late. Berries are

¹ Retired.

picked about once each week for 3 to 5 weeks. Table 1 gives the approximate percentage of the fruit that is harvested each week during the ripening season for the most common varieties, going from the earliest to the latest.

Varieties differ in their ripening season from year to year and to some extent from section to section. Also, the heavy pruning commonly practiced in North Carolina causes the fruit to ripen earlier and in a shorter time than does the lighter pruning practiced in Michigan. The

ripening times given in table 1 are for moderately pruned plants.

Of the principal varieties, the best for western North Carolina, Maryland, and New Jersey are Bluetta, Collins, Blueray, Bluecrop, Berkeley, Jersey, and Lateblue. In eastern North Carolina, the most important varieties are Morrow, Wolcott, Croatan, Murphy, Berkeley, and Jersey. In Michigan and New England, the best varieties are Jersey, Bluecrop, Earliblue, Blueray, Collins, Coville, and Lateblue. And in western Oregon and Wash-

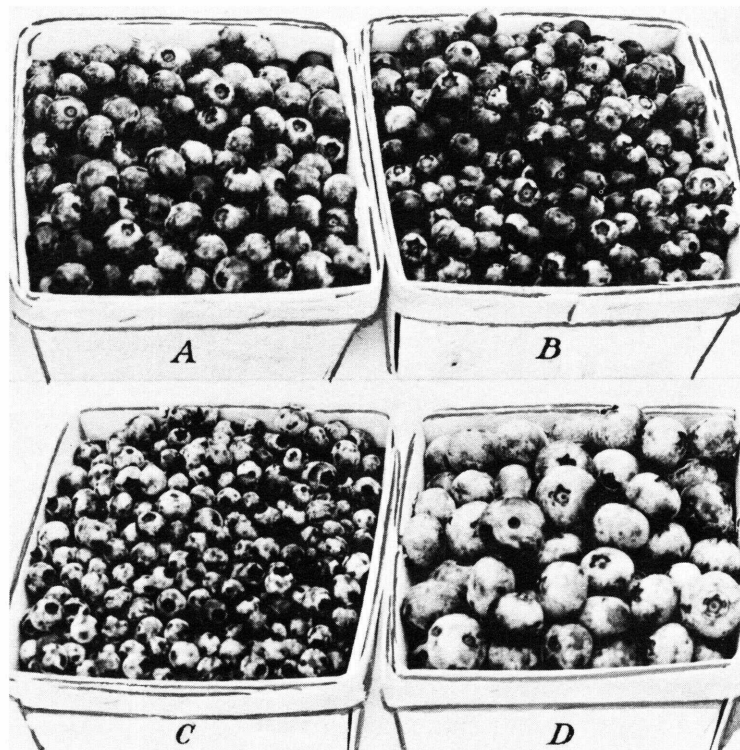


Figure 1.—Berries from different sources: A, Rubel, the best highbush selection from the wild; B, wild highbush blueberry of eastern United States; C, wild lowbush blueberry of the Northern States; D, cross of two highbush varieties. Note the large size of the berries from the cross.

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TABLE 1.—*Percentage of fruit gathered each week during the ripening season for common highbush varieties.*

Variety	First week	Second week	Third week	Fourth week	Fifth week	Sixth week	Seventh week	Eighth week	Ninth week
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Morrow	40	40	20						
Angola	35	30	20	15					
Wolcott	20	40	25	15					
Earliblue	30	40	30						
Weymouth	30	40	30						
Bluetta	40	50	5						
Croatian		40	40	20					
Murphy		20	30	30	20				
Collins		30	40	30					
Blueray		30	30	20	10	10			
Rancocas		30	30	20	10	10			
Bluecrop			20	40	30	10			
Bluehaven			20	40	30	10			
Berkeley				40	30	30	10		
Rubel				20	40	30	10		
Jersey				20	40	30	10		
Dixi					50	40	10		
Herbert					50	40	10		
Burlington					20	40	30	10	
Darrow					30	40	30		
Coville						30	30	30	10
Lateblue							35	35	30

ington, the most commonly grown varieties are Bluecrop, Dixi, Collins, Blueray, Berkeley, Herbert, Darrow, and Coville.

Descriptions of the most commonly grown highbush varieties follow.

Angola.—Bush vigorous, spreading, productive; leaf large; fruit cluster loose; berry medium size, somewhat soft, good aroma, good flavor, early, undesirable dark color; scar medium size; grown only in North Carolina.

Berkeley.—Bush vigorous, spreading, productive; leaf large; fruit cluster loose; berry very large, light blue, firm with slight aroma; less acid than most varieties; good flavor; scar small; stores well; re-

sistant to cracking; late midseason; well liked for its good color, large size, firmness, and productiveness.

Bluecrop.—Bush average vigor, upright, productive; hardier and more drought resistant than most varieties; fruit cluster loose; berry large, light blue, firm, resistant to cracking, slight aroma; scar very small.

Bluehaven.—Bush medium vigor, hardy, productive, upright; fruit large, firm, light blue, small scar, mild flavor; tight cluster; ripens in midseason; variety for Michigan and the Northeast.

Blueray.—Bush very vigorous, upright, hardy, productive; fruit cluster small, tight; berry very

large, light blue, firm, resistant to cracking, excellent flavor, aromatic; scar medium size; ripens in mid-season if pruned heavily.

Bluetta.—Bush medium vigor, spreading, productive; fruit medium size, firm, light blue, good flavor, resistant to cracking; scar medium size; early variety for New Jersey and Michigan.

Burlington.—Bush vigorous, upright; leaf large; fruit cluster medium tight; berry small, blue, firm, slight aroma, good flavor, resistant to cracking; scar small; superior to most other highbush varieties for its hardiness and good cold-storage qualities.

Collins.—Bush vigorous, upright, moderately productive; fruit cluster medium tight, attractive; berry large, firm, light blue, excellent flavor; variety for early mid-season from Maryland northward.

Coville.—Bush vigorous, spreading, productive; leaf large; fruit cluster loose; berry very large, light blue, firm, aromatic, good flavor but tart till ripe, resistant to cracking; ripens late, does not drop; scar small.

Croatan.—Bush vigorous, spreading, productive; leaf large; fruit cluster loose; berry medium to large, dark blue, medium firm, slightly aromatic, good flavor; scar very small.

Darrow.—Bush erect, vigorous, productive; fruit cluster medium size; berry large, light blue, firm, tart until completely ripe but excellent flavor when fully ripe.

Dixi.—Bush vigorous, spreading, productive; leaf large; fruit cluster medium tight; berry large,

blue, firm, aromatic, excellent flavor, subject to cracking; scar large.

Earliblue.—Bush vigorous, upright, productive; fruit cluster loose; berry large, light blue, firm, resistant to cracking, aromatic, good flavor; scar small; early variety for Maryland and northward.

Herbert.—Bush vigorous, upright, productive; fruit cluster loose; berry very large, medium firm, medium blue, resistant to cracking, aromatic, excellent flavor; scar medium size.

Jersey.—Bush vigorous, erect, productive; leaf large; fruit cluster long and very loose; berry medium size, light blue, firm, no aroma, fair flavor; scar small.

Lateblue.—Bush moderately vigorous, upright, productive; fruit cluster loose; leaf large; berry medium large, firm, good flavor; scar medium size; ripens late with many berries ripe at same time.

Morrow.—Bush spreading, slow growing; berry large, medium blue, good flavor, medium firm; ripens earliest of all varieties; grown only in North Carolina.

Murphy.—Bush vigorous, spreading, productive; leaf large; fruit cluster loose; berry medium size, dark blue, firm, slightly aromatic, fair flavor; scar medium size.

Rancocas.—Bush moderately vigorous, erect, productive; leaf small; fruit cluster very tight; berry small, medium blue, firm, crisp, very slight aroma, good flavor, cracks badly after rain.

Rubel.—Bush erect, vigorous, productive; leaf medium size; fruit cluster very loose; berry small, me-

dium blue, firm, slight aroma, fair flavor; small scar.

Weymouth.—Bush erect, spreading, below average vigor; leaf medium size; fruit cluster medium loose; berry large, dark blue, lacking aroma, usually poor flavor; scar medium size.

Wolcott.—Bush very vigorous, upright, productive; leaf large; fruit cluster loose; berry medium size, dark blue, firm, aromatic, good flavor; scar small.

Culture

Cultivated highbush blueberries are raised commercially on acid soils from eastern North Carolina northward to southern New England, in western New York, in southern Michigan, and in western Oregon and Washington.

The plant is not hardy in temperatures lower than about -20°F . Instances have been reported of the tops being killed at a temperature of -30° . However, even in sections where the blueberry is not generally hardy, local conditions of air drainage or protection by deep snow may make blueberry growing possible.

The southern limit for highbush varieties is about 300 miles north of the Gulf of Mexico from Georgia to Louisiana. Highbush blueberry varieties are not successful in Florida, southern Georgia, and southern Louisiana because the winters are too short for the plants to break their winter rest period and blossom normally.

Highbush varieties begin to ripen the latter part of May in Georgia and eastern North Carolina, the last of June in New Jersey, and mid-

July in Massachusetts and Michigan.

The highbush blueberry grows best where the soil is very acid and moist. Usually the best growth occurs where the acidity ranges from pH 4.3 to 4.8. Good growth may occur in soils with a pH as low as 4. However, where the pH is as low as 4, ground magnesium limestone should be applied to bring the soil pH up to 4.5.

Where the soil pH is as high as 5.5, finely ground sulfur or ammonium sulfate may be used. If the soil is sandy or sandy containing peat, ammonium sulfate should be used as it both acidifies the soil and furnishes nitrogen. If the soil is a loam, it may contain enough nitrogen, and sulfur may be used to acidify it. Iron chelates are used to correct chlorosis of blueberry foliage that results from high pH.

The best indication that blueberries may succeed on a soil is that they or some related plants such as huckleberries, azaleas, or laurel are growing there naturally. Open porous soils of sand and peat that contain an admixture of loam, and have a water table 14 to 30 inches below the surface, are best for blueberries.

The blueberry plant is shallow rooted; therefore, cultivation should be shallow. Deep disking that cuts off roots near the base of the plant is destructive. Clean cultivation has been the usual practice, but cover crops should be used to prevent erosion and soil impoverishment. A summer cover crop sown just after harvest is recommended.

The plants can be set 4 or 5 feet apart in one direction and 9 or 10

feet apart in the other as early in the spring as the soil can be worked. Setting the plants 4 by 9 feet (1,210 per acre) or 4 by 10 feet (1,089 per acre) is best for new plantings.

Plants are set in spring in most areas, but in New Jersey some planting is done in the fall; in eastern North Carolina, planting is done in late fall and winter.

For growing blueberries successfully, the plants must be vigorous and produce good crops each year. On fertile soils very little fertilizer may be required, but on poor soils larger amounts may be necessary to maintain satisfactory growth.

In locations that do not have special fertilizer requirements, use 400 to 600 pounds per acre of a complete fertilizer (about 8-8-8 not neutralized) in the spring after the buds start. This should be followed about 6 weeks later, if the soil is pH 4.8 or above, by an application of 100 pounds of ammonium sulfate per acre and followed by one or possibly two similar applications at intervals of 6 weeks.

The more fertile fields in the Northern States should not have the later fertilizer applications. The fertilizer should be broadcast to within 6 to 12 inches of the plant and out as far as the roots extend.

In New Jersey and North Carolina, additional nitrogen is often needed.

The blueberry plant is not drought resistant. It is a native of moist lands, but fields should be well drained. Low lying soils usually selected for blueberries often have depressions or pockets from which the water does not drain and

the blueberry plants are drowned unless drainage is provided.

Vigorous productive bushes can grow only where the soil is not saturated with water during the growing season and only for short times during the dormant season.

Under favorable conditions, an extensive root system develops that can support a large bush and crop. If the roots are soaked for several days because of heavy rains or poor drainage, the root system may be weakened or the plants killed. Sometimes, when the lower part of the root system is killed by water injury and a drought follows, the whole plant may die.

In most areas where blueberries are grown, droughts are severe enough to injure plants and reduce crops. When this is the case, growers should provide for irrigation. Many blueberry growers use an overhead sprinkler system, which can be used for frost protection also. Irrigation drainage ditches can be used to remove excess water quickly during or after storms.

In times of drought, 1 to 2 acre-inches of water should be applied about 10 days apart during the picking season and as needed later in the season during the heat of summer.

Mulching with sawdust, hay, or straw to a depth of several inches keeps down weeds, keeps the soil cooler in summer, helps to retain soil moisture, and helps to control erosion. The plant rows may be covered 2 to 2½ feet on each side, or the entire area may be mulched.

Leguminous hay mulches such as clover or soybean have sometimes

been injurious and should not be used unless a thorough trial has shown no injury over a period of a year or more. When sawdust, leaves, hay, or straw are used, additional nitrogen must be applied to get good growth.

Where mulches are not used, 100 pounds of ammonium sulfate per acre should be applied. On mulched areas, applications of 300 pounds per acre each should be used 6 weeks apart.

Cross-pollination by bees is necessary for maximum production of all commercial varieties of blueberries. Bees increase the number of berries set, shorten the ripening period, and cause the berries to be larger. To improve pollination, the grower should alternate one or two rows of one variety with one or two rows of another that overlaps in flowering time.

Native wild bees usually are inadequate so they should be supplemented by one to five strong colonies of domestic bees per acre. For most efficient use of the bees, they should be distributed so that flights do not exceed 200 to 300 yards.

Pruning

The blueberry produces fruit on wood of the previous season's growth. The largest fruit is borne on the most vigorous wood. Most varieties tend to overbear, and unless part of the buds are pruned off, the berries are small and there is too little vigorous new growth for the next year's crop.

The erect growing varieties need to be thinned at the center, and the spreading varieties are likely to

need their lower drooping branches pruned. Sometimes, when the crop is heavy and no pruning is done, few berries mature.

Heavy pruning should rarely be practiced. It consists of thinning the small branches, heading back clusters, and cutting out some of the old stems. This reduces the crop greatly and hastens ripening. The heavier the pruning, the larger the berry size, the earlier the ripening, and the smaller the total crop for that year.

Light pruning consists of thinning out some of the small branches and an occasional stem. Although this reduces the crop for a particular year, it increases the size and earliness of the berries and tends to produce more vigorous new growth for the next year's crop.

It is possible to shift the ripening period by the amount of pruning done. In North Carolina and other Southern States, heavy pruning at a sacrifice of yield may be practiced to obtain an early-maturing crop. In the Northern States, the practice of light pruning may spread the ripening season over several weeks.

Less pruning is needed on vigorous plants. Heavily fertilized plants that have plenty of soil moisture at all times are much stronger and produce many more large berries than plants lacking in fertilizer and soil moisture.

Usually very little pruning is necessary until the end of the third season, when regular annual pruning should ordinarily begin. The general practice is as follows:

(1) The low spreading branches next to the ground should be cut out,

leaving only the more erect branches or shoots.

(2) If the center of the bush is dense, the weak and the older branches at the center should be cut out.

(3) Most of the small slender branches should be removed, leaving the strong branches and shoots (fig. 2).

Small weak branches cause the bush to become too dense, make picking difficult, and leave inadequate space for strong new shoots. The small branches of Rubel, Bluetta, and Rancocas bushes require much thinning out and are, therefore, expensive to prune.

To increase the size of the berries, the fruiting shoots of small-fruited varieties should be cut back, the amount depending on the number

of fruit buds on the shoots. Earli-blue, Collins, Bluecrop, Blueray, Berkeley, Herbert, and Coville require very little cutting back. The amount of cutting back necessary depends on growing conditions and varies from year to year.

Cutting back is usually done after danger of cold injury is past. General pruning may be done at any time from leaf fall in the autumn to the beginning of growth in the spring. The yield of fruit from blueberry plants under different types of pruning is shown in table 2.

Propagation

With careful attention, blueberry plants can be propagated by either hardwood or softwood cuttings. Softwood cuttings are used very little commercially.

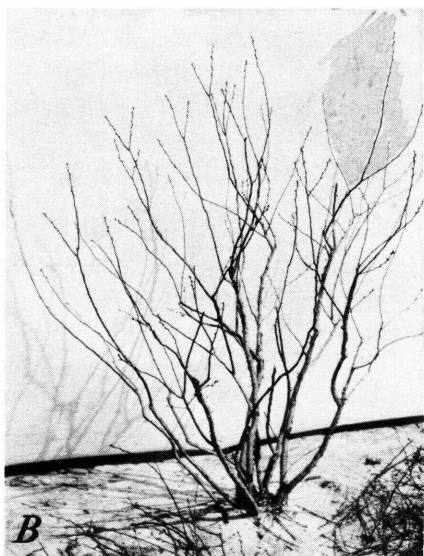
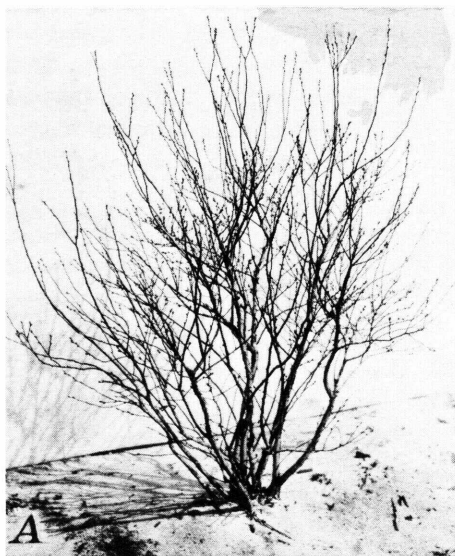


Figure 2.—Four-year-old blueberry bush: A, Before pruning; B, after pruning. Pruning reduced the fruit buds by about 75 percent. In very fertile soils, a large number of fruit buds might be left for a heavier crop.

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Hardwood cuttings, 4 to 5 inches long, are made from dormant shoots of the previous season's growth; the lower cut is made just below a bud and the upper cut just above a bud (fig. 3). Wood with fruit buds should be cut off and discarded because cuttings with fruit buds seldom root or make good plants.

The cuttings may be rooted in ground beds covered by lath shade screens about 7½ feet above the ground (fig. 4), in covered frames, in unshaded beds with automatic watering, and in plastic covered ground beds. Ground beds are those made directly on the ground; they are usually filled with a mixture of half peat and half sand to a depth of 6 inches.

The most commonly used covered frames are 6 feet long, 27 inches wide, and 16 to 40 inches high. The frames contain trays 4 inches deep with the bottom made of one-eighth-inch to one-fourth-inch mesh hardware cloth or fly screen. The trays rest on cleats 8 to 10 inches below the top of the frame. The trays are filled with peat or peat and sand, and the cuttings are placed in a slanting position about 1 inch apart in rows 2 inches apart.

An advantage of the tray is that it can be moved to a coldframe or to the nursery; cuttings in the ground bed require transplanting. The practice in Michigan is to cover each frame with a sash and then with coarse burlap; in New Jersey, shade is not essential but sometimes either slat or lath covers are used.

In cool areas, bottom heat at 70° F. improves the rooting of hardwood cuttings.

TABLE 2.—*Yield of fruit from blueberry plants under different types of pruning.*

Type of pruning	Berries per plant	
	First season	Second season
	<i>Pounds</i>	<i>Pounds</i>
None-----	23. 4	20. 1
Light-----	17. 3	19. 9
Medium-----	16. 3	14. 3
Heavy-----	7. 6	8. 1
Very heavy-----	3. 9	9. 1

Varieties that are relatively easy to root from cuttings are Angola, Croatan, Morrow, Murphy, Wolcott, Earliblue, Collins, Blue-ray, Bluetta, Herbert, Rancocas, Rubel, Berkeley, and Coville; those that are less easily rooted from cuttings are Bluehaven, Darrow, Lateblue, and Jersey. Bluecrop is difficult to root from cuttings.

Cuttings are made during winter when the plants are dormant. They may be stored in a cool, moist place until they can be set in the propagating beds in early spring. Usually they have rooted by June (fig. 3) but are left in the ground beds or, if propagated in covered frames, they are placed in coldframes until the following spring.

Cuttings usually are grown for a year in the nursery before being planted in the fields. The nursery rows usually are 18 inches apart and the plants 6 to 10 inches apart in the row. After a year in the nursery, they are called 2-year plants. Well grown 2-year plants are considered most desirable for field planting.

Rabbiteye

Some cultivated rabbiteye varieties bear large, juicy, aromatic fruit that compares favorably with that born by highbush varieties. Rabbiteye berries from the wild are mostly black and less attractive than the large, blue-fruited, cultivated varieties.

Rabbiteye blueberries are chiefly important because they grow in upland areas where highbush will not and because they require a very

short rest period in winter. Also, rabbiteye varieties are not so sensitive to soil type and are far more resistant to heat and drought than highbush.

Rabbiteye succeeds from eastern North Carolina south to central Florida and west to Arkansas and east Texas (fig. 5).

Varieties

Characteristics of some of the most common rabbiteye varieties

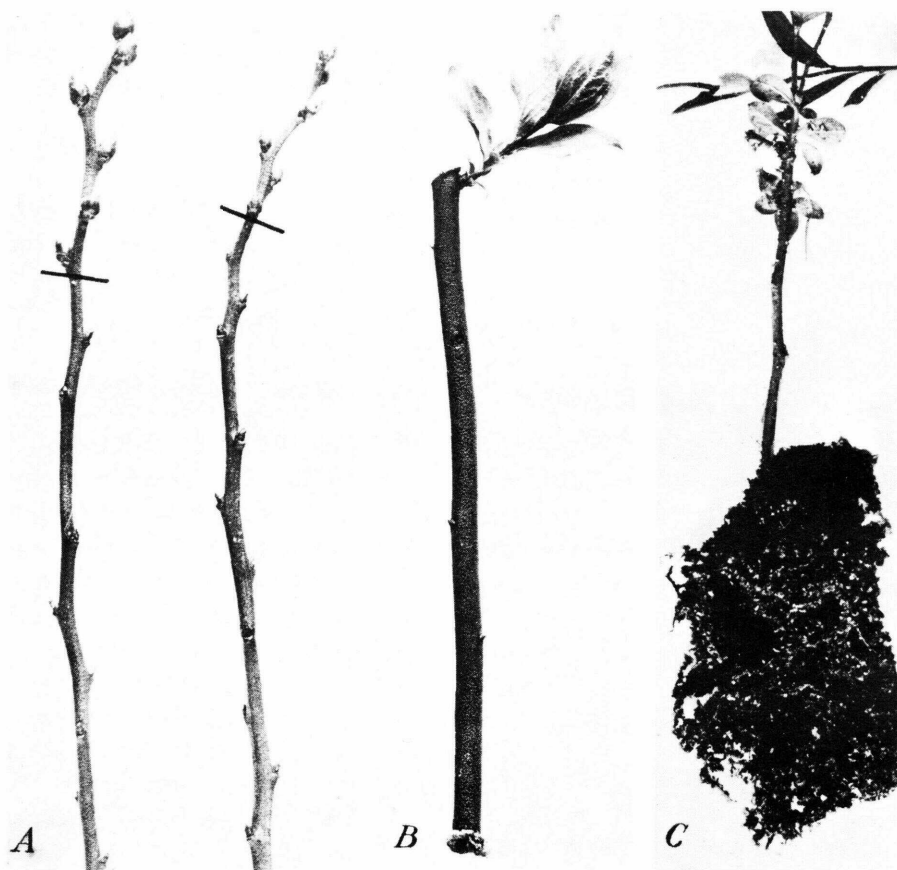
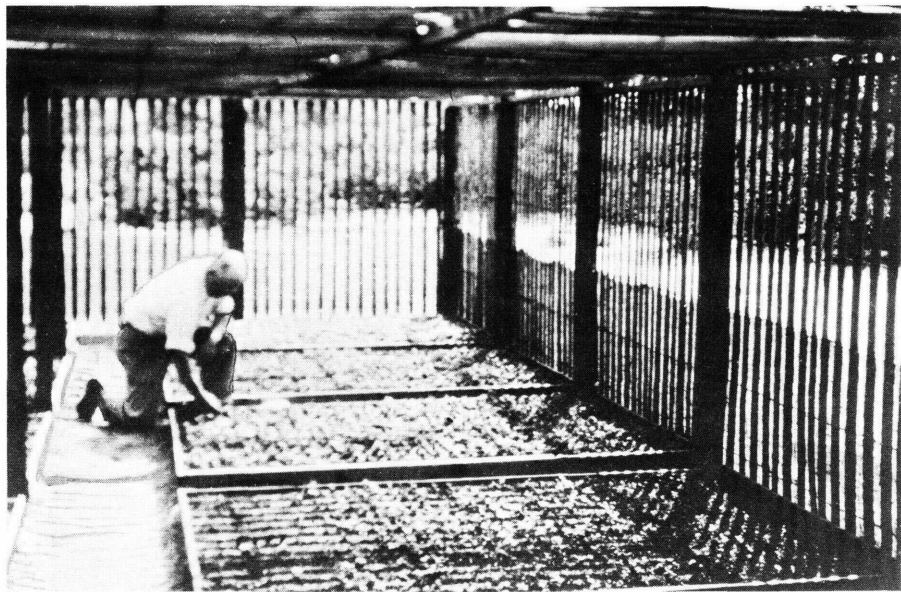


Figure 3.—A, Hardwood cuttings with fruit buds at tip; these should be cut off as indicated. B, Cutting with a shoot at the upper end and a good callus but no roots at the base. Roots should appear within a few days. C, Well-rooted cutting.

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Figure 4.—Propagation of blueberries by hardwood cuttings in ground beds made up of half peat and half sand in a shade house with lath sides and top that gives about one-half shade.

are given in table 3. Woodard is the earliest and largest of the rabbiteye varieties and Woodard and Tifblue have the best flavor. Homebell has large fruit and a very vigorous, productive bush. Tifblue is the lightest blue of all the rabbit-eye varieties.

Culture

Rabbiteye blueberries (fig. 6) are generally set in midwinter in rows 12 feet wide with the plants 6 to 12 feet apart, depending on cultivation practices in the area. Use liberal quantities of peat moss at time of planting. Under good conditions, plants grow rapidly and bear small commercial crops by the third year. Two rows alternating with two other rows of a different variety

should be planted because cross-pollination is necessary.

Cultivation of rabbiteye blueberries is the same generally as for highbush. They respond to tilling, mulching, and fertilizing. However, young plants are sensitive to fertilizer so only small amounts or none should be applied the first growing season.

Yields increase rapidly after the fourth year. In one experiment, Tifblue plants averaged 2.2 pints in the fourth season, 5.1 in the fifth, and 14.1 in the sixth. Twenty pints per plant are not unusual.

Pruning is not generally practiced, but the fruiting habit of the rabbiteye is similar to the highbush, and some pruning of older bushes is desirable. The older stems and smaller young shoots may need thin-



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Figure 5.—A planting of rabbiteye blueberry. Plantings of 50 to 100 acres are not uncommon.

ning to prevent the bushes from becoming too dense.

Pruning should be relatively light because rabbiteye plants are sufficiently vigorous to support and develop heavy crops of large-size fruit. Heavy pruning results in excessive water-sprout growth.

Under the same growing conditions, the fruit of most rabbiteye blueberries ripens later and over a longer season than highbush. Picking in northern Florida usually begins near the end of May.

Although rabbiteye varieties generally ripen their fruit over a longer period than highbush, some of the newer rabbiteye varieties ripen most of their fruit within a 30-day period. Some rabbiteye varieties have firmer fruit and a much smaller scar than do highbush varieties.

Rabbiteye plants can be propagated by offshoots, or suckers, which

grow from the roots at distances of a few inches to 8 feet from the parent plant. Suckers usually are grown in the nursery for a year before they are set in their permanent location.

Propagation by softwood summer cuttings under intermittent mist is very successful. Hardwood cuttings of rabbiteye varieties root poorly.

Softwood cuttings with three or four leaves per cutting are superior to those with one or two leaves per cutting. Peat or a one to one mixture by volume of peat and perlite is used as a rooting medium in a ground bed or cold frame with partial shade to protect against direct sunlight.

WILD BLUEBERRIES

Fruit worth several million dollars annually is harvested from the wild, especially in the New Eng-

TABLE 3.—*Rabbiteye blueberry varieties ranked according to certain characteristics.*

Rank	Season	Size of fruit	Flavor	Color	Firmness	Yield	Bush size
	<i>Early to late</i>	<i>Large to small</i>	<i>Good to fair</i>	<i>Light to dark</i>	<i>Firm to soft</i>	<i>High to low</i>	<i>Large to small</i>
1.---	Woodard	Woodard	Delite	Briteblue	Tifblue	Tifblue	Tifblue
2.---	Homebell	Tifblue	Woodard	Tifblue	Briteblue	Woodard	Homebell
3.---	Garden Blue	Menditoo	Tifblue	Woodard	Southland	Delite	Delite
4.---	Tifblue	Briteblue	Garden Blue	Southland	Delite	Homebell	Garden Blue
5.---	Menditoo	Delite	Menditoo	Delite	Woodard	Southland	Southland
6.---	Southland	Homebell	Homebell	Garden Blue	Homebell	Garden Blue	Woodard
7.---	Briteblue	Homebell	Southland	Homebell	Menditoo	Menditoo	Menditoo
8.---	Delite	Garden Blue	Briteblue	Menditoo	Garden Blue	Briteblue	Briteblue

land States and from Gifford Pinchot and Mt. Hood National Forests in Washington and Oregon where several million pounds are picked each year. Other national forest areas where wild blueberries are harvested are the Dolly Sod and Spruce Knob areas of Monongahela National Forest in West Virginia, and the Shining Rock and Tanasee Bald areas of Pisgah National Forest in North Carolina.

Wild blueberries are also harvested in several other widely separated areas. They are the blueberry barrens and uplands of New York, Pennsylvania, West Virginia, Michigan, Wisconsin, and Minnesota; the swamplands along the Atlantic coast and in the Northeastern States; the upland sections of Alabama, Georgia, and other Southern States; the Cascade Mountains section of Oregon and Washington; and the coastal section of northern California, Oregon, and Washington.

Figure 7 shows the location of the areas in the United States from which wild berries are most extensively harvested and marketed.

Lowbush

The lowbush blueberry, the most important commercial wild species, is native to Northeastern United States and parts of Canada. In the United States, fruit from this species is gathered in commercial quantities from Maine to Minnesota and southward in the Alleghenies to West Virginia.

Lowbush is an upland species. The plants are 6 to 18 inches high and grow into large colonies by

means of underground shoots. No varieties have been propagated for commercial planting, but selections have been made for breeding because this species crosses readily with the highbush blueberry.

The fruit, which is usually light blue, ripens earlier than the fruit of highbush; the flavor is similar. Although the fruit ripens during July and August, harvesting may extend into September in the most northern areas.

The fruit is gathered for the canneries with rakes (fig. 8) that are

similar to cranberry scoops, but much smaller. For the fresh-fruit market, the fruit is harvested by hand as well as with rakes.

After a forest has been cut or burned over, lowbush blueberries come in naturally in large areas of some of the Northern States. If burning is prevented, the area grows up in brush and woodland again. Therefore, areas that yield large quantities of berries for a few years may produce none later because the brush crowds out the blueberry bushes.



Figure 6.—Mature rabbiteye blueberry bushes, showing the many shoots and great height of some varieties of this species.

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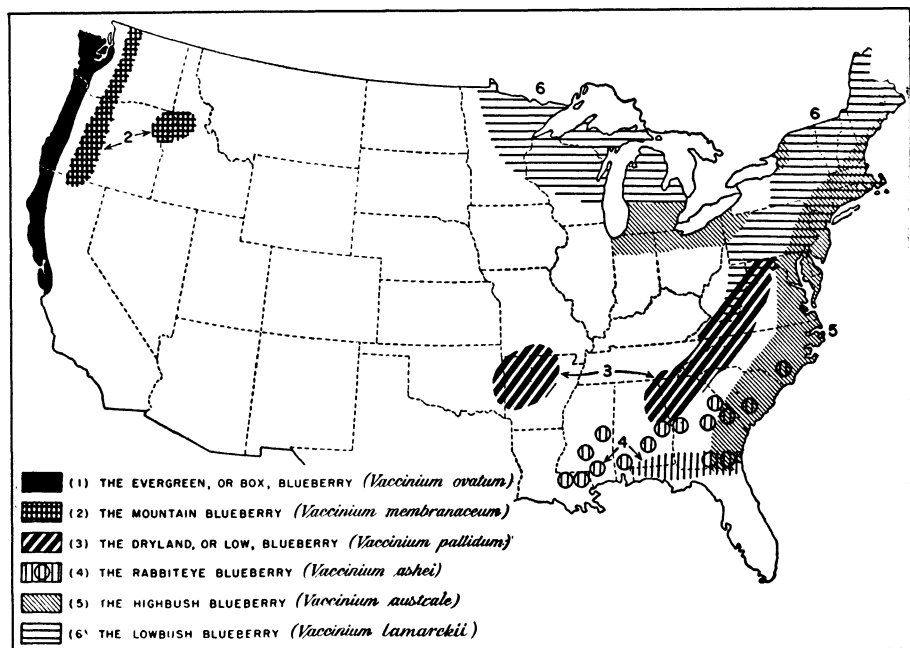


Figure 7.—Map of the United States, showing areas in which wild blueberries are extensively harvested.

In eastern Maine and in some smaller areas elsewhere, the fields are reburned every second or third year in spring while the ground is still wet. This kills weeds and underbrush and prunes the blueberry plants. Most of the burning is done with machines that use oil or liquefied petroleum gas.

As a further aid in control, weeds and brush may be cut or pulled in the fall previous to burning or they may be killed by brush-killing chemical sprays. Burning over does not seriously injure the blueberry plants if properly done during the dormant season, but repeated burning lowers soil fertility.

The fruit should be picked as early as possible before the berries are infested by the blueberry fruit-fly. In Maine, picking for the fresh-

fruit market begins about July 20 and for the canneries about August 10. Fruit is harvested from about 150,000 acres of native, wild blueberries in Maine (fig. 9).

Dryland

The dryland blueberry, also commonly called the low huckleberry, is native from Georgia and Alabama to Maine and westward to Michigan and Oklahoma. It is important chiefly in northern Alabama and Georgia and northward to Maryland and West Virginia. The plants grow in the dry, relatively poor soils of ridges and hills and are very drought resistant.

The fruit is gathered most extensively in northeastern Alabama, northwestern Georgia, West Virginia, and western and north-



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Figure 8.—Harvesting lowbush blueberries for the canneries. The rake is 10 to 12 inches wide and has 18 to 40 teeth.

western Arkansas. Dryland blueberry plants grow from 1 to 3 feet high and spread in colonies much as do lowbush blueberries.

The berries have a light blue color and their flavor is good. They have a small, rather dry scar where the stem was attached. Dryland blueberries commonly ripen later than either lowbush or highbush.

Evergreen

The evergreen blueberry, commonly known as the evergreen or coast huckleberry, is a native along the Pacific coast from central California to British Columbia. The fruit is gathered extensively in northern California, along the coast of Oregon and Washington, and in the Puget Sound district.

The plant is an attractive ornamental shrub (fig. 10) and may grow to 20 feet in open woods. Branches of this blueberry are used as decorations. They are shipped chiefly from December to March to eastern cities under the name of evergreen huckleberry.

The berries ripen from August to November but the peak ripening period is in September and October. The berries usually are small and shiny black and have a strong flavor that is not like that of other blueberries. This flavor makes them less desirable than other blueberries for eating fresh. A large part of the crop is stored frozen for use by pie makers.

The evergreen blueberry grows only in the mild climate near the Pacific coast and around Puget Sound. It has not been hardy in Eastern United States.

Mountain

The mountain blueberry, also called broadleaved huckleberry, is a native of the high slopes of the Cascade Mountains of Oregon and Washington and eastward to Wisconsin. It is most abundant near Crater Lake, Mount Hood, Mount Adams, and Mount Rainier.

It is a very drought-resistant plant, matures its fruit in the late summer even after 3 or 4 rainless

months, and is important for forage. The plants grow 3 to 5 feet high and are abundant in burned-over areas.

In the Cascade Mountains area, the mountain blueberry is one of the best flavored and largest fruited of all wild blueberries. The berries are somewhat pear shaped, black or maroon in color, juicy, highly flavored, and rather tart but not too tart to be eaten fresh.

Because the berries are borne singly (fig. 11) or in pairs rather than in clusters like those of other blueberries, the bushes are not highly productive.

HARVESTING AND MARKETING

The first berries from the early varieties are picked about May 15 in North Carolina, June 15 in New Jersey, and July 10 in southern Michigan. From three to seven pickings are made at 5- to 7-day inter-

vals. In any one locality the season usually lasts 6 to 7 weeks.

To provide the best possible supply to markets, the North Carolina growers are mainly interested in early to midseason varieties and the New Jersey and Michigan growers in midseason and late ones. In 8 hours a picker can harvest 60 to 80 pints, or even more, where the crop is heavy. Pint baskets are used mostly as containers but they must be made tighter than those used for larger fruits such as strawberries.

Machine harvesting of the fruit is increasing. Two types of machines are in use. One type is a hand-held vibrator that is powered by electricity and has a catching frame (fig. 12). The other type is a self-propelled over-the-row machine that shakes off the fruit (fig. 13). Three sizes of the self-propelled machine are available.

Fruit harvested by machine usually must be cleaned and sorted be-



Figure 9.—Part of the blueberry barrens, which cover more than 100,000 acres in Maine. Most of the blueberries are lowbush.

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fore it can be sold. Most machine-harvested fruit is processed and not marketed fresh.

Most of the crop in North Carolina, New Jersey, and Michigan is marketed cooperatively. The berries are sold according to size-grades. Larger berries usually bring a higher price than smaller ones. However, in early and late parts of the harvesting season, small berries sometimes bring higher prices than large berries do in midseason.

Yields vary greatly. In some areas, yields from the second to the sixth year may increase from 50 to 6,000 pints per acre. Larger yields

are possible. Full production is reached in 6 to 10 years, but it may be reached earlier if the plants are cared for properly.

Plants should produce a little fruit 1 year after planting. When mature, they usually bear 14 to 16 pints per plant with medium pruning, and they may produce 20 to 23 pints per plant with no pruning (table 2).

Although much of the crop from cultivated fields is marketed fresh, large quantities of highbush blueberries are canned or frozen. Canned and frozen berries are used mostly for pies.

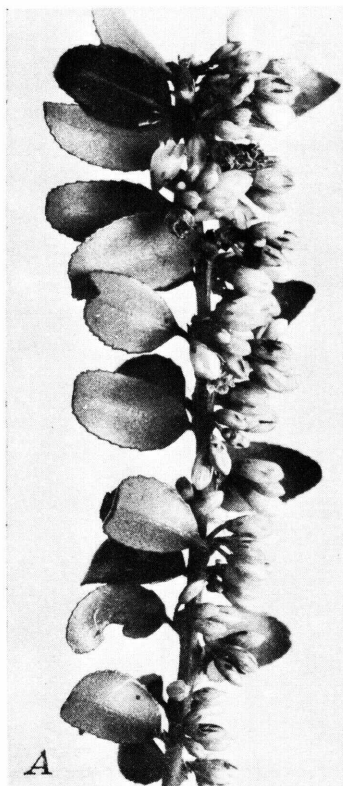


Figure 10.—Shoots of the evergreen blueberry: A, Showing flower buds and flowers at most nodes; B, fruiting clusters.

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Figure 11.—A branch of the mountain blueberry.

PEST CONTROL

Several kinds of pests attack blueberries. These include weeds; fungus, virus, and bacterial diseases; nematodes; and insects. Measures that may be taken to control these pests are discussed in this section.

Weeds ²

Weeds may be controlled with preemergence or postemergence herbicides, depending on the weed problem. Preemergence herbicides are applied to the soil before weeds appear; postemergence herbicides are applied to the weeds after they appear. Herbicides that may be used are listed in this section. The

amounts given for each herbicide are in pounds of active ingredient per acre.

Some preemergence herbicides are as follows:

Diuron [3 - (3,4 - dichlorophenyl)-1,1 - dimethylurea].—Use 2 to 2.4 pounds.

Simazine [2 - chloro - 4,6 - bis (ethylamino) - s - triazine].—Use 2 to 4 pounds.

Dichlobenil [2,6 - dichlorobenzo-nitrile].—Use 4 to 6 pounds.

Dichlobenil will control certain established perennial weeds but the other preemergence herbicides generally will not control established weeds.

Preemergence herbicides may control weeds for 3 to 6 months.

Diuron and simazine are usually applied in spring prior to bloom. Diuron should not be applied until the blueberry plants have been es-

² Prepared by W. V. Welker, Jr., horticulturist, Northeastern Region, Agricultural Research Service.

tablished at least one year. Dichlobenil is more effective when applied in cool weather, therefore, it should usually be applied in fall or winter. None of these herbicides should be applied to the foliage of the blueberry plant.

Caution: Carefully follow the instructions and cautions on the container label.

Diseases ³

The loss of blueberries from diseases is more serious in North Carolina than in other sections. Stem canker causes the most dam-

age, followed by foliage diseases, stunt virus, stem blight, and phytophthora root rot.

In New Jersey, stunt virus and mummy berry are the most serious diseases, followed by ringspot virus and anthracnose.

In Michigan, blueberries are most seriously damaged by fusisocum canker, phomopsis canker, and mummy berry. Stunt virus and shoestring virus cause some damage.

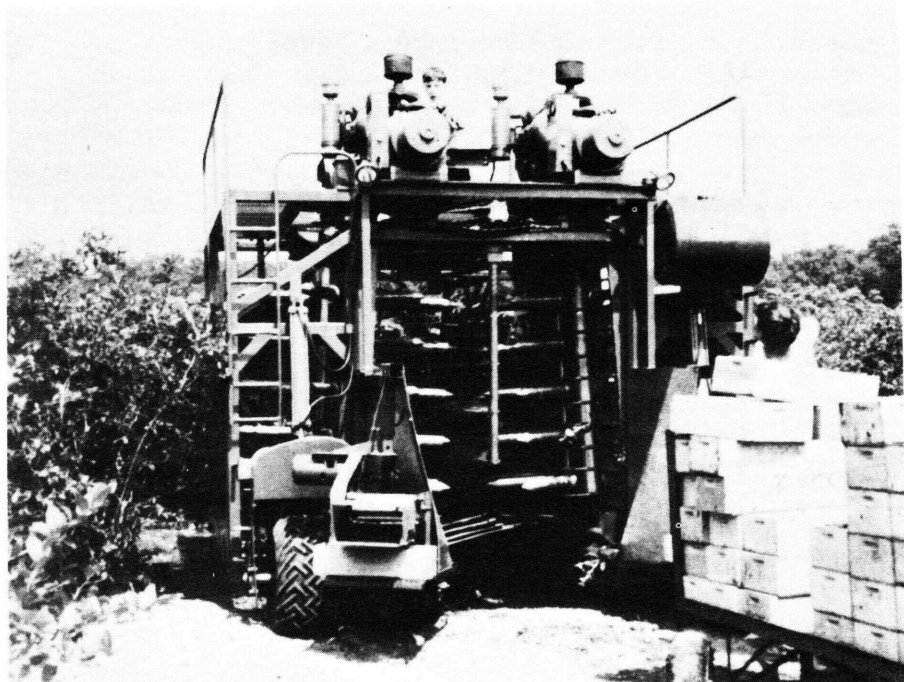
In the Pacific Northwest, mummy berry is serious and difficult to con-

³ Prepared by A. W. Stretch, Northeastern Region, Agricultural Research Service.



BN-3910

Figure 12.—An electric-powered, hand-held, blueberry harvester that shakes the berries into a catching frame.



BN-39105

Figure 13.—A self-propelled, over-the-row blueberry harvester.

trol. Botrytis twig and blossom blight also causes damage.

Botrytis twig and blossom blight, red leaf, mummy berry, and powdery mildew are serious diseases on lowbush in Maine.

Fungus Diseases

Mummy berry.—Mummy berry attacks blueberries in all producing areas but it is primarily a problem in the North.

Newly emerging stems and flower clusters are blighted by the initial fungus infection in the spring. Spores then infect healthy blossoms and eventually kill the developing fruit. As the berries approach maturity they become mummified and drop to the ground where they overwinter. The following spring a new

cycle of the disease is started from the overwintered mummies.

Varieties differ in their susceptibility to the mummy berry fungus. Burlington, Collins, Jersey, Darrow, Rubel, Bluetta, and Dixi are most resistant to the fungus. Rancocas, Weymouth, Berkeley, Bluecrop, Herbert, and Coville are less resistant. The most susceptible varieties are Earliblue and Bluegray.

The disease is controlled by mechanical or by chemical destruction of the mummies, or by protection of the bushes with fungicide. Clean cultivation in the spring destroys the mummies and helps stop the disease.

A chemical that may be used to control mummy berry is ferbam. Mix 1 pound and 2 ounces of active

ferbam in 100 gallons of water and use 200 to 250 gallons per acre per application. Apply two to four sprays at 2-week intervals beginning at budbreak to control the disease in the blight stage on highbush blueberries.

On lowbush blueberries, use 7-percent ferbam dust at 15 pounds per acre to control the blight phase. Start applications at budbreak and continue them until berries form. Burning lowbush plants when they are dormant will stimulate new growth and destroy the mummies.

Powdery mildew.—Powdery mildew attacks blueberries in most growing areas. It may not cause direct yield losses but it causes premature leaf drop in the fall and weakens the plants. Leaf surfaces are whitened by the fungus.

Varieties of highbush blueberries differ in their susceptibility to powdery mildew. Berkeley and Earliblue are highly resistant; Bluecrop, Coville, Dixi, Rancocas, and Weymouth are moderately resistant; and Blue-ray, Burlington, Collins, Darrow, Herbert, Jersey, and Rubel are susceptible.

Fungicides are seldom used to control powdery mildew on highbush. However, the disease can be controlled by using 20-percent sulfur dust at 25 pounds per acre, beginning just after bloom and continued at 2-week intervals through the season.

Use resistant varieties where possible.

A 7.6-percent ferbam dust applied at 15 to 20 pounds per acre just after bloom and again 10 to 14 days

later will control mildew on lowbush.

Fusicoccum canker.—Fusicoccum canker attacks blueberries in northern growing areas, particularly in Massachusetts and Michigan.

The first symptom is the appearance of small, reddish spots on the canes, which are frequently centered about a leaf scar near the ground. As the canker enlarges, a bull's-eye pattern develops. Sudden wilting and dying of canker-girdled canes in warm, dry weather is the most obvious symptom.

Jersey is very susceptible to fusicoccum canker, followed closely by Earliblue and Bluecrop; Coville, Berkeley, Blue-ray, Burlington, and Rubel are moderately susceptible; and Rancocas is resistant.

Diseased prunings from plants should be removed and burned to aid in control.

Phomopsis twig and cane blight.—Phomopsis twig and cane blight attacks blueberries in most commercial producing areas but is especially serious in Michigan.

Plants infected by this fungus usually are in a weakened condition. Symptoms of blight occur on young succulent twigs and then progress downward as the fungus invades the crown. Older canes are girdled and the foliage on such canes may suddenly wilt and die during hot weather.

The disease is best controlled by maintaining plants in vigorous condition and by burning diseased parts when they are pruned.

Botrytis twig and blossom blight.—The gray mold fungus causes botrytis blight in the coastal blueberry areas of Maine, Washington, and Oregon where cool temperatures, long periods of rainfall, and high humidity favor botrytis development. Favorable conditions for botrytis develop occasionally in New Jersey also.

Blight symptoms first appear at the tips of young twigs and may progress down the entire length of the twig. Blighted flowers remain on the plant much longer than undamaged flowers and, later in the season, fruit may rot in the field or after it is picked.

Heavy fertilization and frequent irrigation stimulate succulent plant growth that encourages botrytis infection. To control the infection on lowbush blueberries, use dusts of 7.6-percent ferbam or ziram applied at 15 to 20 pounds per acre when the blossoms first open. Repeat the treatment twice more, depending on the duration of wet periods.

No control has been established for blight on highbush.

Anthracnose.—The anthracnose fungus causes fruit rot of mature berries, but it also infects leaves, twigs, and green fruit. In recent years, losses have increased at harvest and during marketing. Anthracnose occurs in New Jersey, North Carolina, Michigan, and Illinois.

Anthracnose produces salmon-colored spore masses on the surface of mature fruit. This disease has attacked Bluecrop, Bluejay, Coville, Jersey, and Rancocas in New Jersey and Wolcott in North Carolina.

For control, prune all dead branches and remove and burn all prunings. An effective fungicide program consists of six to seven sprays beginning at midbloom. Use ferbam at 2 pounds of 76-percent wettable powder in 100 gallons of water at 10- to 14-day intervals to within 40 days of harvest. Then use captan at 2 pounds of 50-percent wettable powder in 100 gallons of water up to harvest at the same time interval.

Botryosphaeria stem canker.—*Botryosphaeria* stem canker is especially destructive on highbush blueberries in North Carolina and other Southern States. The disease is rare in New Jersey and remains localized.

The first symptom is a small reddish, conical swelling on new twigs that enlarges in summer and early fall. Fungus growth spreads in succeeding years and causes swollen, fissured cankers that girdle and kill the stems.

Varieties of highbush differ widely in their susceptibility to the stem canker fungus. Murphy, Morrow, Wolcott, Jersey, Angola, and Croatan are resistant to one or more races of the fungus but not to all races. Varieties of rabbiteye listed in table 3 are highly resistant to stem canker.

The only control is the use of resistant varieties.

Phytophthora root rot.—*Phytophthora* root rot attacks blueberries in North Carolina, Maryland, and New Jersey. The symptoms of the disease are leaf yellowing, weak growth with some drying up of leaf

margins, small terminal leaves, defoliation, root rot, and plant death.

Cultivated highbush varieties are very susceptible to root rot but cultivated rabbiteye varieties are highly resistant to the fungus.

When planting new fields, avoid low, poorly drained areas because the fungus thrives in these places.

Blueberry stem blight.—Blueberry stem blight attacks plants in North Carolina and New Jersey.

One or more dead branches near living branches that have normal green leaves is the most conspicuous symptom. Leaves on affected branches may be yellow or reddish in the early stages of infection. Infected woody stem tissue turns a pecan brown.

No control is known for this disease.

Leaf spot.—Both septoria leaf spot and double spot are found in the southern growing areas. Septoria occurs in North Carolina, Georgia, and Florida but double spot appears only in North Carolina.

The septoria fungus causes small, circular, white lesions that have a purple border. The lesions appear on leaves and new stem growth. Severe defoliation may result from septoria infections.

Double spot can be serious in May and June if rains are frequent. Initially the spots are small and circular and have a dark brown ring around a light brown center. The fungus grows through the outer ring about midsummer and produces a larger spot, which gives the disease the name double spot.

Both septoria and double spot can

be controlled with ferbam or Dyrene⁴ spray. Use 1½ pounds of active ferbam or 1 pound of active Dyrene per 100 gallons of water. Apply spray in sufficient quantity to wet foliage completely. Spray after the plants have finished blooming. In North Carolina, continue spraying at 2-week intervals until early September.

Red leaf disease.—Red leaf is a fungus disease that is serious on lowbush blueberries in Maine and other New England States. It sometimes attacks cultivated highbush blueberries in Massachusetts, New Jersey, and Michigan.

The symptoms are reddening of the leaves and fungus growth on lower leaf surfaces. Affected leaves drop off in midsummer and plants produce few berries.

The only control is to kill the diseased plant by spot treatment with the herbicide 2,4-D. Follow the directions on the container for mixing the spray.

Witches' Broom.—Witches' broom attacks both highbush and lowbush blueberries in the northern blueberry region.

The fungus causes lateral buds to grow and gives rise to a broomlike mass of swollen shoots. The fungus that causes the disease must complete part of its life cycle on balsam fir as an alternate host. The fungus must go from blueberry to fir and

⁴Trade names are used in this publication solely to provide specific information. Mention of a trade name does not constitute a guarantee of the product by the U.S. Department of Agriculture nor does it imply an endorsement by the Department over comparable products that are not named.

back to blueberry again because spores produced on blueberry will not infect other blueberries.

Where witches'-broom is a serious pest, it may be necessary to remove or destroy all balsam fir within several hundred yards of the blueberry field.

Leaf rust.—Leaf rust is serious on lowbush blueberries in Maine and it appears sporadically on highbush in the Eastern United States, particularly in the South.

The fungus completes part of its life cycle on hemlock, where it overwinters. Infected leaves have light green to reddish areas on the upper surface and rust colored pustules on the lower surface.

Highbush varieties differ in their resistance to leaf rust. Jersey and Rubel are susceptible; Dixi, Rancocas, and Weymouth are resistant.

Measures have not been established to control attacks on highbush blueberries. On lowbush, a 7-percent ferbam dust applied at 15 to 20 pounds per acre at petal fall and again 10 to 14 days later is recommended.

Virus Diseases

Blueberry stunt.—The most widespread, destructive virus disease of highbush blueberries is stunt. It is found from North Carolina to eastern Canada and west to Michigan.

Stunt slows down growth and gives the plant a yellow, dwarfed appearance. Characteristic symptoms are small, cupped leaves yellowed along the margins and between lateral veins, and short twig growth.

Branches become twiggy and a

premature, brilliant red coloring develops in the yellowed areas of the diseased leaves. The fruits are small, lack flavor, and remain attached to the plant much longer than normal.

Cultivated highbush varieties are all susceptible to stunt but Rancocas is more resistant than other varieties.

The use of virus-free plants, removal of diseased bushes, and control of the sharp-nosed leafhopper provide excellent control of stunt. Insecticide applications of parathion at 2 pounds of 15-percent wettable powder per acre in late spring, late summer, and early fall will control leafhopper.

In new plantings, use certified virus-free plants and in established plantings, remove diseased plants after each leafhopper insecticide application. Destruction of wild blueberries along the edges of fields will also eliminate a source of infection.

Mosaic.—Mosaic is common on highbush blueberries in New Jersey, North Carolina, and Michigan.

Infected leaves have mottled patterns of yellow and yellow-green areas. Diseased plants are unproductive.

The only recommended controls are prompt removal of diseased plants and use of disease-free planting stock.

Shoestring.—Shoestring virus disease is common on highbush blueberries in New Jersey and Michigan. Infected plants produce little new growth and no fruit.

The first symptoms of shoestring virus appear in the spring as red

streaks on new shoots and red vein-banding on the leaves. The shape of diseased leaves varies from narrow and straplike to wavy and sickle-shaped. Infected flowers are deformed and streaked with pink. Immature fruit develops a premature red to purple color on the surface exposed to the sun.

The only controls are prompt removal and destruction of diseased plants and the use of virus-free planting stock.

Red ringspot.—Red ringspot is a virus disease of wild and cultivated highbush blueberries. The disease attacks wild blueberries only in New Jersey but it attacks cultivated plantings in Michigan, Connecticut, North Carolina, Long Island, Massachusetts, and New Jersey.

The greatest loss from the disease is the difficulty it causes in the propagation of virus-free plants. However, it can cause some berry losses from small, misshapen fruit.

The first symptoms of the disease are red spots or rings on older leaves. The earliest appearance of the disease is in New Jersey in June or early July. The symptoms are less severe in younger leaves. The leaf spots have well-defined margins and do not show on the lower surface of the leaves. Red ringspot may also cause red spots or rings to develop on stems.

Powdery mildew symptoms may be confused with red ringspot but powdery mildew causes dead looking irregular spots on the underside of the leaves.

Most cultivated highbush blueberry varieties are susceptible to red ringspot. Of the major varieties

only Jersey appears immune; Bluecrop and Weymouth have high resistance.

The only controls are to use virus-free planting stock and to promptly remove diseased bushes.

Necrotic ringspot.—Necrotic ringspot is caused by a virus commonly known as tobacco ringspot virus. Necrotic ringspot attacks both wild and cultivated blueberries in Michigan, New Jersey, Connecticut, New York, and Illinois but it is not serious in most cultivated fields.

The disease causes stunting, extensive dieback, and unproductivity. Young leaves show yellowed spots, rings, and line patterns. Dagger nematode (*Xiphinema americanum*) is a vector of tobacco ringspot virus and is probably the vector of necrotic ringspot.

Control measures are removal of diseased bushes, treatment of soil with nematicides, elimination of other hosts of the tobacco ringspot virus, and the use of disease-free plants. See the section entitled "Nematodes."

Bacterial Diseases

Bacterial canker.—Bacterial canker occurs in cultivated highbush plantings in Washington and Oregon.

The symptoms are water soaked areas on 1-year-old stems that rapidly become reddish brown to black cankers. The first symptoms usually appear in January or early February; the earliest appearance of the disease is in Oregon.

Susceptibility varies among varieties. Jersey and Coville are severely

affected; Rubel and Burlington are seldom affected; and Weymouth and Rancocas are highly resistant.

To control the disease, spray with a fixed copper compound during the dormant season.

Crown gall.—Crown gall is found in all northern highbush growing areas where it is primarily a problem in nurseries but is occasionally a problem in cultivated fields.

Tumorlike outgrowths appear on low branches, small twigs, and the base of canes near the ground line. The outgrowths are black or dark brown, rough, and hard.

The best control is to propagate only from healthy plants and to immediately remove and destroy all prunings suspected of having crown gall. Sterilize contaminated pruning tools with an antiseptic before reuse on healthy plants.

Nematodes ⁵

Blueberries are attacked by several species of nematodes. The most damaging are root-knot (*Meloidogyne* spp.), sting (*Belonolaimus* spp.), root-lesion (*Pratylenchus* spp.), stunt (*Tylenchorhynchus* spp.), spiral (*Helicotylenchus* spp.), stubbyroot (*Trichodorus* spp.), and dagger (*Xiphinema* spp.), nematodes.

Nematodes cause poor stands, slow plant growth, and reduced fruit size and yields. The root systems of severely injured plants are galled (root knots), greatly re-

stricted, and often matted and rotted. The foliage may be yellow and leaves may drop early, especially during a drought.

Nematodes can cause extensive damage in both nurseries and field plantings. No varieties are resistant to nematodes.

The use of nematicides provides the best nematode control (table 4). DD, 1,3-D, EDB, and DBCP control only nematodes. DD+MENCS, methyl bromide, and SMDC also control many weeds, insects, and soil borne diseases; they are especially desirable for use in nurseries (fig. 14).

Rates of application of nematicides vary according to soil conditions and method of application. Always follow the manufacturer's directions on the package label for specific recommendations.

If they can be obtained, use only nematode-free plants for established field plantings.

Insects ⁶

The number of insects attacking blueberries is extensive. The most common ones are the blueberry maggot, the cranberry fruitworm, the cherry fruitworm, the blueberry bud mite, the plum curculio, and the cranberry weevil.

Other insects that attack blueberries are leafhoppers, budworms, tent caterpillars, webworms, datana worms, leaf rollers, scale insects, stem borers, and cranberry rootworm. For help in identifying in-

⁵ Prepared by J. M. Good, nematologist, Extension Service.

⁶ Prepared by P. H. Schwartz, entomologist, National Program Staff, Agricultural Research Service.



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Figure 14.—A comparison of the size of blueberry plants grown in untreated soil, left, and in soil treated with nematicides.

sect pests and their control you may wish to consult your local county agricultural agent or State agricultural experiment station.

Fruit Worms

Adult moths of the cranberry fruit worm appear during late May and early June. They lay their eggs in the calyx cup at the base of newly set fruit. The larvae are greenish underneath and on the sides, brownish red on the back, and up to one-half inch long.

The small gray moths of the cherry fruit worm appear late in the blooming season and do not lay eggs in large numbers until the bloom is nearly off. The larvae are uniform reddish orange and up to three-eighths inch long.

Green fruit is attacked by the larvae of fruit worms; a few worms can destroy large numbers of berries.

Both of these insects are distributed from Maine to Texas.

Apply carbaryl at 1.5 pounds of active ingredient per acre or malathion at 1.0 pound per acre, using three applications at 10-day intervals beginning just after petal fall.

Blueberry Maggot

Adult blueberry maggots are similar to houseflies in shape. They are about three-sixteenths inch long, have a brown face and shiny black body, are white on the sides and rear of the thorax, and have several white bands on the abdomen. The

wings are clear with black bands. The larvae are yellow-white maggots up to three-eighths inch long.

The larvae attack the berries. Infested berries may drop, reducing the crop yield. The maggots puncture the skins and feed on the flesh, causing the berries to collapse due to loss of flesh. Usually only one maggot is found per berry.

The blueberry maggot is distributed from New Jersey northward.

Apply malathion at 1 pound active ingredient per acre, beginning near the end of June and re-apply at 10-day intervals as long as harvest continues. Do not apply malathion within 1 day before berries are harvested.

Blueberry Bud Mite

Blueberry bud mites are only about $\frac{1}{128}$ inch long, are soft bodied, have eight legs, and are not classified as insects.

The blueberry bud mite sucks juices from the buds. Flowers may

be distorted and fail to set fruit. Berries may only partially develop and the skin of the berries may be rough. Red, blistered, misshapen berries are the first signs of injury.

This mite is a serious pest in North Carolina and to a lesser extent in New Jersey.

Apply $1\frac{1}{2}$ pounds of active ingredient per acre of endosulfan in 300 gallons of water immediately after harvest and repeat 6 to 8 weeks later. Do not apply endosulfan after buds are well formed.

Cranberry Weevil

Adult cranberry weevils are dark reddish brown, about one-third inch long, have white patches across the wings, and have a slightly curved snout one-third as long as the rest of the body. The larvae have a whitish, legless body up to one-ninth inch long and a yellow head.

Adult weevils bore into leaf and fruit buds and eat the flesh. When

TABLE 4.—*Suggested nematicides for control of nematodes on blueberries.*

Chemical	Active ingredient per acre as overall treatment
	<i>Pounds</i>
DD (mixture of 50% 1,3-dichloropropene and 50% 1,2-dichloropropane).....	250 to 600.
1,3-D (100% 1,3-dichloropropene and related chlorinated C ₃ hydrocarbones).....	200 to 480.
DD+MENCS (mixture of 80% DD and 20% methyl isothiocyanate).....	145 to 240.
EDB (83% ethylene dibromide).....	90 to 108.
SMDC (sodium methyl dithiocarbamate).....	124 to 338.
DBCP (1,2-dibromo-3-chloropropane).....	14 to 26.
Methyl bromide ¹	175 to 412.
Methyl bromide ²	435 to 872.

¹ This methyl bromide treatment is for general use.

² This methyl bromide treatment is only for nursery use on plant beds.

the blossoms start turning white, the weevils lay their eggs in the flower. After the larvae hatch, they eat the entire contents of the flower. Crops are severely reduced.

These weevils are distributed east of the Rocky Mountains.

For control, keep fields clean by cultivation; kill hibernating weevils by burning the trash and dry weeds off the unused land immediately surrounding fields in spring before buds begin to swell.

Plum Curculio

The adults are dark brown beetles one-fourth inch long that have grayish or whitish patches on the back and four humps on the wing covers. The larvae are grayish white, legless, and curved-bodied; they have a small brown head and are up to one-third inch long.

Adults appear early in the blooming period, feed, and lay their eggs in small green berries. Usually there is one larva in each berry. The larvae feed on the fruit, causing the fruit to drop.

This insect is distributed east of the Rocky Mountains.

Methods used to control fruitworm will also control the plum curculio.

PRECAUTION

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do

not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your county agricultural agent or State Extension specialist to be sure the intended use is still registered.